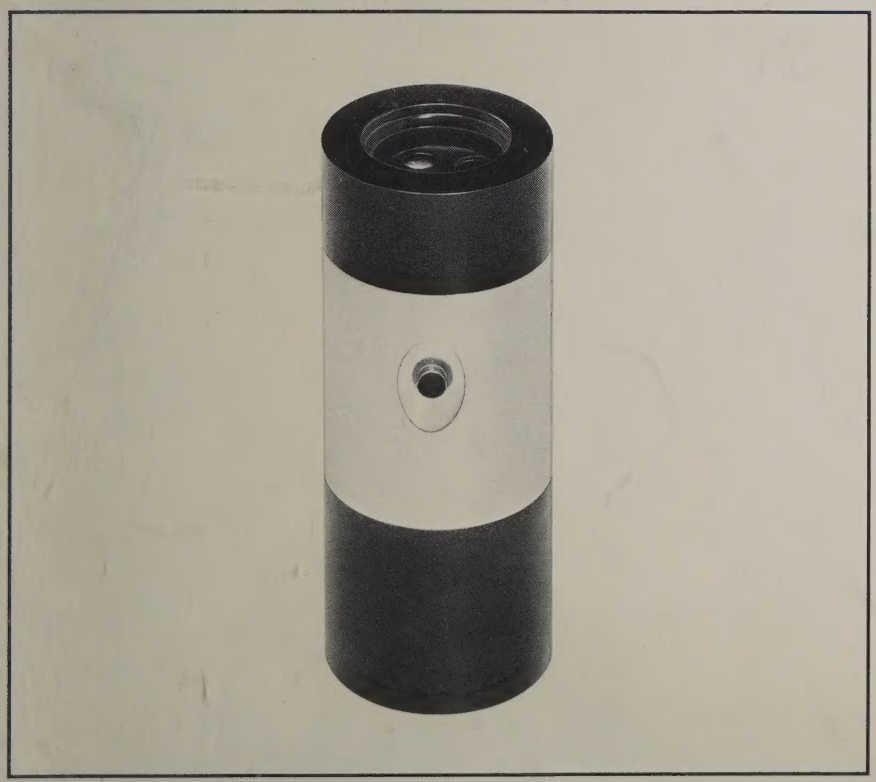
B-28

Instruction Manual 4230

WARNING

This instrument should use premium grade corrosion resistant dry cells. Low cost cells may leak and ruin the battery housing. The warranty on this instrument excludes corrosion damage from leaking dry cells.

Sound Level Calibrator Type 4230



A simple to use, pocket size, acoustic calibrator which gives an accurate sound pressure level of 94 dB at 1000 Hz.

Brüel & Kjær

033-0273

SOUND LEVEL CALIBRATOR
TYPE 4230

Revision December 1977

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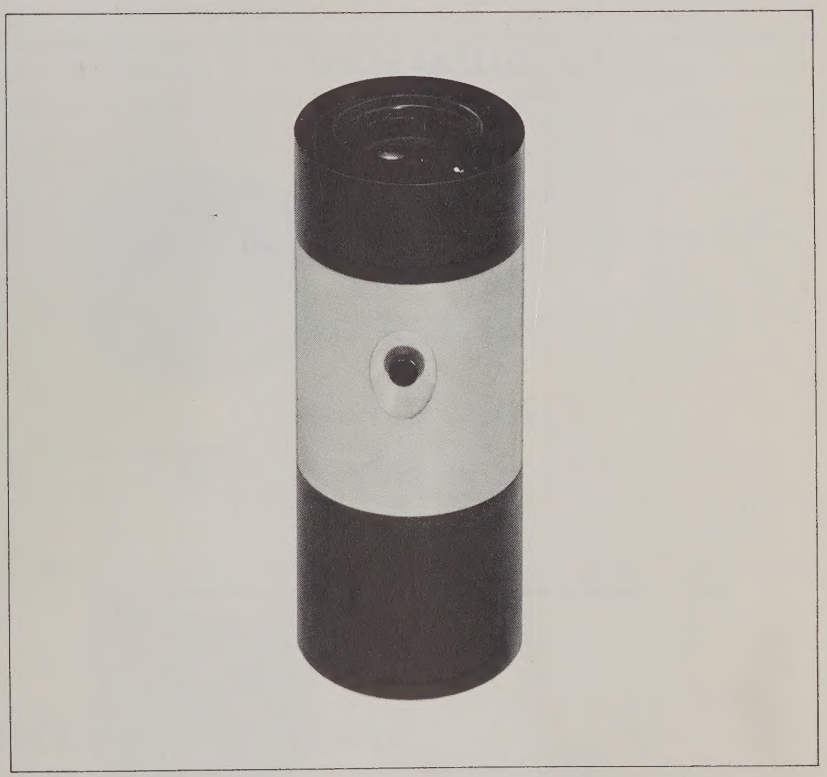
Sound Level Calibrator

FEATURES:

- Pocket size, portable unit
- Calibration accuracy ± 0,25 dB
- Frequency 1000 Hz, gives independence of weighting networks
- Calibration sound pressure level 94 dB = 1 Pascal= 1 N/m² = 10 μbar
- Extremely small influence of static pressure
- Sound pressure independent of microphone equivalent volume
- Fits B & K 1" and 1/2" microphones

USES:

- Calibration of sound measuring equipment



This calibrator enables easy calibration of sound measuring equipment in the field. To operate it, push it onto the microphone, press the calibrator push-button and adjust the meter to show the correct reading. When the push-button has been pressed to start the calibration, the signal will last up to 1 minute (depending on battery condition), leaving one hand free to make adjustments.

The calibration frequency is 1000 Hz, (the reference frequency for the standardized international weighting networks), so the same calibration value is obtained for all weighting networks (A, B, C, D and Linear). The calibration pressure of 94 ± 0,25 dB re 2×10^{-5} N/m² is equal to 1 Pa or 1 N/m², convenient for calibration. The principle of operation of the calibrator is shown in Fig. 1. A stabilized 1000 Hz oscillator feeds a piezoelectric driver element which vibrates the diaphragm and creates the sound pressure level in the coupler volume. The system is driven at its resonant frequency, at which the equivalent coupler volume is more than 200 cm³. The sound pressure is therefore independent of the microphone's volume and the accuracy with which it is connected to the calibrator, an added assurance for non-experts.

Normally, the volume behind the diaphragm would have a certain stiffness which would be pressure dependent and would add to the overall stiffness of the system. This in turn would make the resonant frequency of the system pressure dependent. However, in the 4230 calibrator the volume behind the diaphragm is shaped like a Helmholtz res-

onator, which eliminates the stiffness factor and makes the resonant frequency independent of ambient pressure. (The resonant frequency of a Helmholtz resonator depends only on the volume of the cavity and the length and cross section of the constricting neck). This means that the calibrator keeps its good characteristics even at very low static pressures.

The accuracy of calibration is within ± 0,25 dB at 25°C and within ± 0,5 dB over the operating temperature range of 0 to 50°C.

The battery condition is easily checked. If the signal stops as soon as the push-button is released, the battery needs replacing.

A leather protecting case which does not need to be removed to use the calibrator is supplied.

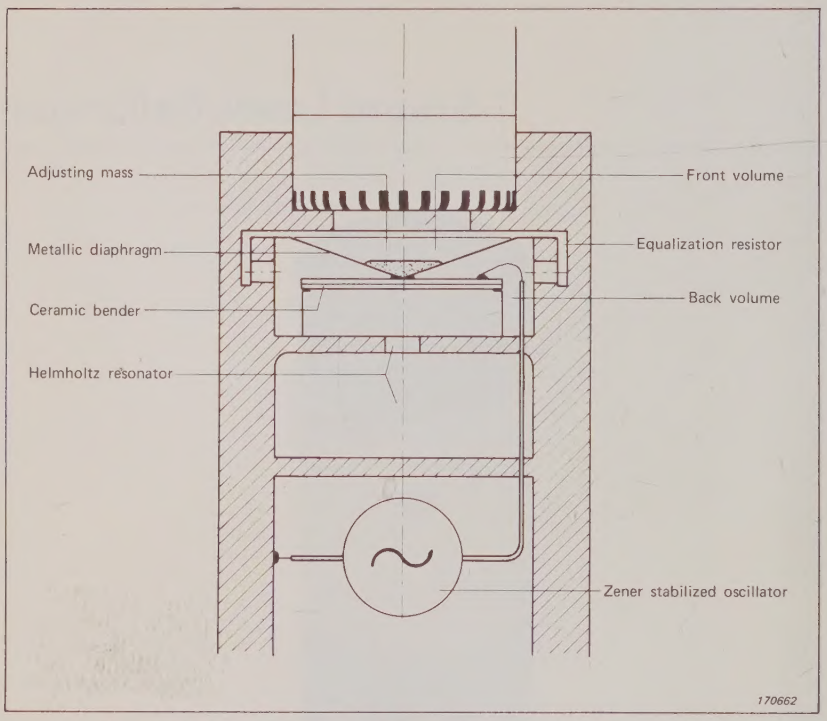


Fig.1. Principle of operation of the portable Sound Level Calibrator 4230

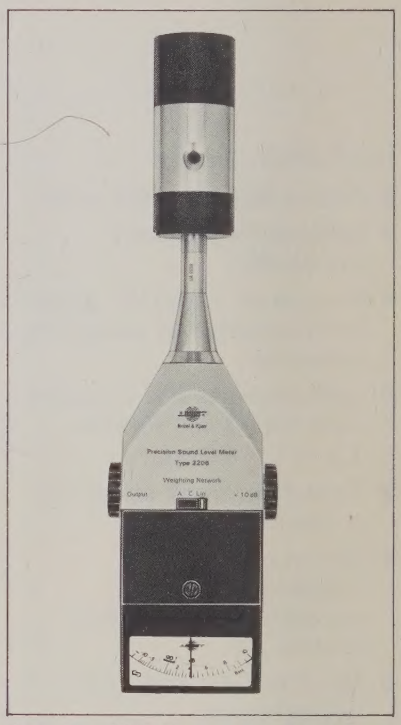


Fig.2. The 4230 fitted to the Sound Level Meter 2206

Specifications 4230

Frequency:
1000 Hz ± 1,5%

Sound Pressure Level:
94 dB re 2×10^{-5} N/m²

Accuracy:
± 0,25 dB at 25°C (77°F)
± 0,35 dB between 10 and 40°C (50 to 104°F)
± 0,5 dB between 0 and 50°C (32 to 122°F)

Equivalent Coupler Volume:
|V| >200 cm³ at 25°C (77°F)
|V| > 100 cm³ between 10 and 40°C (50 to 104°F)
|V| >50 cm³ between 0 and 50°C (32 to 122°F)

Influence of Static Pressure:
± 0,05 dB/100 mbar from 500 to 1100 mbar

Distortion:
< 1%

Power Supply:
Built-in battery: 9 V IEC 6F22

Operation:
With a new battery the signal will last for up to one minute after contact is released

Battery Check:
As long as the signal continues for a few seconds after the contact is released the change in SPL is < 0,05 dB

Dimensions:
(Including leather case)
Length: 110 mm (4,35 in)
Diameter: 44 mm (1,73 in)

Weight:
(Including leather case)
260 g (0,57 lb)

Accessories Included:
Adaptor for 1/2" microphones DB 0311
Leather case KE 0065
Battery 9 V IEC 6F22 QB 0010

2. OPERATION

2.1. GENERAL

The 4230 is designed for the calibration of 1" and 1/2" diameter microphones. An adaptor is placed over the opening for use with 1/2" microphones and is removed when 1" microphones are to be calibrated (Fig.2.1). The Calibrator should be stored and operated in its leather case.

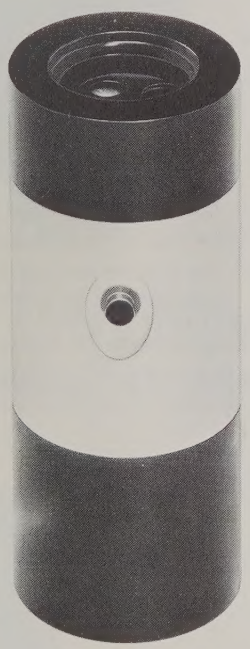


Fig.2.1. Sound Level Calibrator Type 4230

The sound pressure level produced by the 4230 is 94 dB re 20 μPa. However, when calibrating a microphone which is to be used for free field measurements, a small correction is necessary to compensate for the difference between free field response at 0° incidence and the pressure response. The correction is —0,4 dB for 1" free field microphones and —0,2 dB for 1/2" free field microphones. This makes the effective calibration levels 93,6 dB and 93,8 dB re 20 μPa respectively. No correction is required when calibrating pressure response microphones.

Adaptors are available so that the B & K 1/4" and 1/8" microphones can be calibrated using the 4230. For 1/4" microphones, the adaptor DB 0310 is required. For 1/8" microphones both adaptors DB 0310 and DB 0352 are required. In each case the extra adaptors fit inside the 1/2" microphone adaptor supplied (DB 0311).

2.2. CALIBRATION PROCEDURE

Pressure Response		94 dB
Free Field Response	1 inch microphones	93.6 dB
	1/2 inch microphones	93.8 dB

Table 2.1. Indication required from measuring equipment for various microphone types

1. Select and fit the requisite adaptor to the 4230.
2. Place the 4230 snugly over the microphone.
3. Press the button on the 4230. A hold circuit maintains the signal for up to one minute (with a new battery) after the push button is released.
4. Adjust the sensitivity of measuring equipment to read the appropriate value (see Table 2.1).

2.3 REPLACEMENT OF BATTERY

If the calibration signal lasts only a few seconds after the push-button on the 4230 has been released then the battery needs replacing. To do this, the 4230 is taken out of its leather case and the bottom part of the calibrator housing is unscrewed, exposing the battery. (Fig.2.2). The battery is a 9 V type IEC 6F 22 or NEDA 1604 and has the B & K order number QB 0010.

The battery is replaced and the 4230 reassembled.

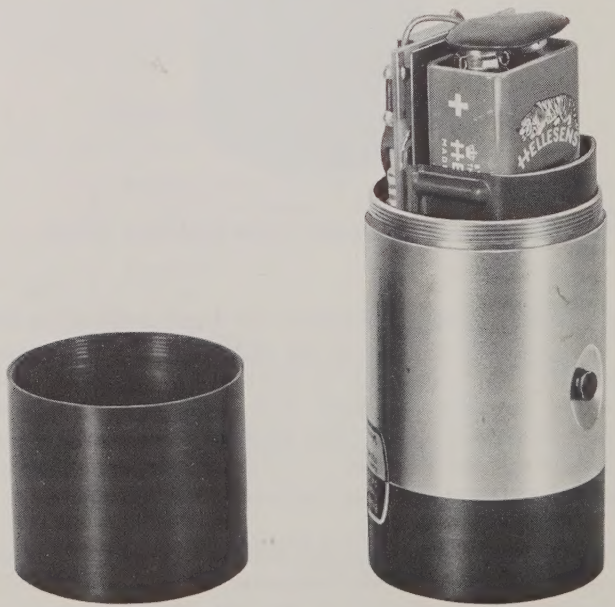


Fig.2.2. 9 V Battery installed in the Calibrator

2.4. LEATHER CASE

Fig.2.3. Calibrator in its Leather Case

The leather case which is supplied with the 4230 is designed to protect it and is best left on the instrument except when changing the battery. The case is padded to protect the instrument against shocks. The case also protects against dust and the effects of sudden temperature changes, such as holding a cold 4230 in a warm hand while performing a calibration.(Fig.2.3.)

3. CHARACTERISTICS

3.1. INFLUENCE OF TEMPERATURE AND PRESSURE

The influence of atmospheric pressure variations on the sound pressure level produced by the 4230 is shown in Figs.3.1 and 3.2. Fig.3.1 shows the quantity which must be added to the basic ± 0,25 dB uncertainty in the calibration for pressures from 500 mbar. Fig.3.2 shows the influence of the high pressure environments on the operation of a number of 4230's.

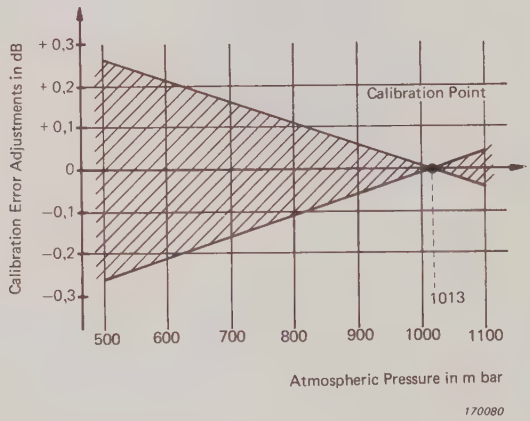


Fig.3.1. Calibration Error Caused by Variations in Atmospheric Pressure at 25°C

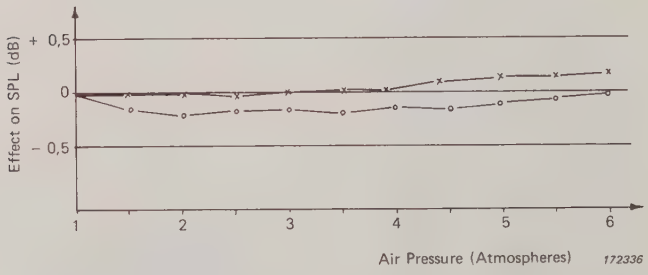


Fig.3.2. Influence of Atmospheric Pressure on SPL of Typical Sound Level Calibrator Type 4230 (1 Atmosphere = 1013 mbar)

The influence of the ambient temperature on the basic ± 0,25 dB uncertainty in the calibration is shown in Fig.3.3.

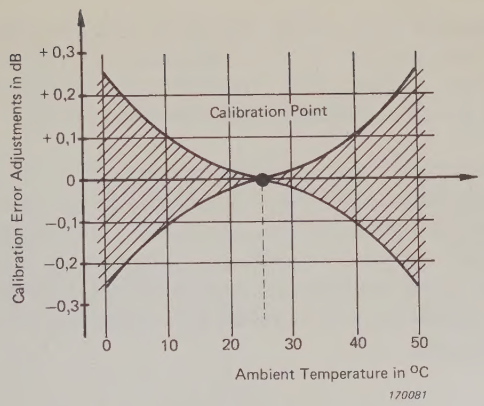


Fig.3.3. Calibration Error caused be variations in temperature at 1013 mbar

3.2. DESCRIPTION AND EQUIVALENT CIRCUIT

A cross-sectional view of the Calibrator is shown in Fig.3.4. It consists of a Zener stabilized oscillator which delivers current via a potentiometer to a piezoelectric crystal. The crystal is soldered onto a metallic suspension system, which is designed so that its influence on the stiffness of the crystal is minimized. The force generated by the crystal is transformed by a conical nickel-membrane to a sound pressure in the coupler to which the microphone is subjected.

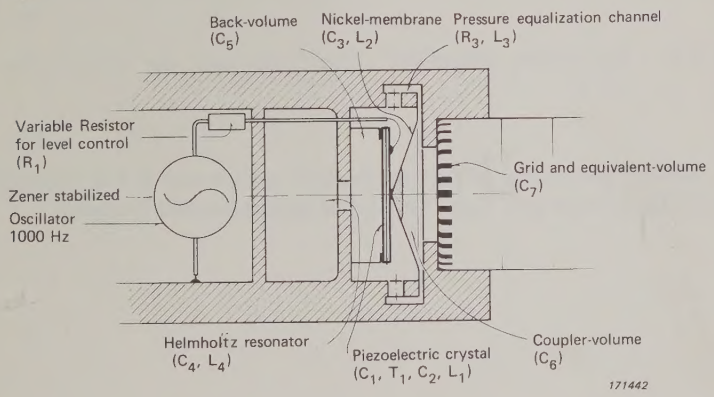


Fig.3.4. Cross sectional view of the 4230

The conical part of the membrane forms a stiff piston while the plane edge of the membrane is elastic. To obtain low acoustic impedance from the point of view of the coupler volume, the moving mechanical parts of the system are adjusted to resonate at 1000 Hz which is the signal frequency of the Calibrator. Since the mass and stiffness of the membrane and crystal would give a higher resonant frequency, the frequency can be lowered by adding a mass to the membrane.

It is desirable to eliminate the cavity stiffness behind the membrane since it changes in proportion to the atmospheric pressure and would therefore influence the resonant frequency of the system. This is achieved by coupling a Helmholtz resonator (with resonant frequency 1000 Hz) to the back volume, giving a very low acoustic impedance at this frequency.

A pressure equalization canal between the coupler and the cavity behind the membrane is incorporated in the calibrator, to reduce the large pressure variations caused by "piston" effects, when microphones are coupled on and off, which could otherwise damage both the Calibrator and the microphones.

An equivalent circuit for the above mentioned elements is shown in Fig.3.5. The impedance analogy has been used, i.e. mechanical or acoustic mass is replaced by an inductance, compliance (1/stiffness) by capacitance, and damping by electrical resistance. The dimensions of the single elements are determined partly by calculation and partly by transferring the given mechanical and electrical data of the crystal to acoustical units, taking into consideration the area of the membrane through which the real acoustical elements are coupled.

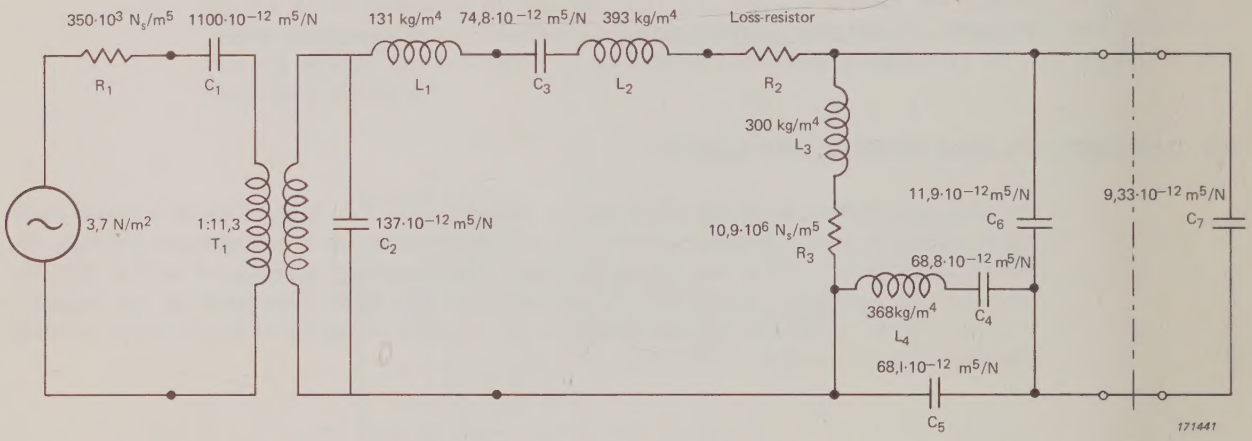
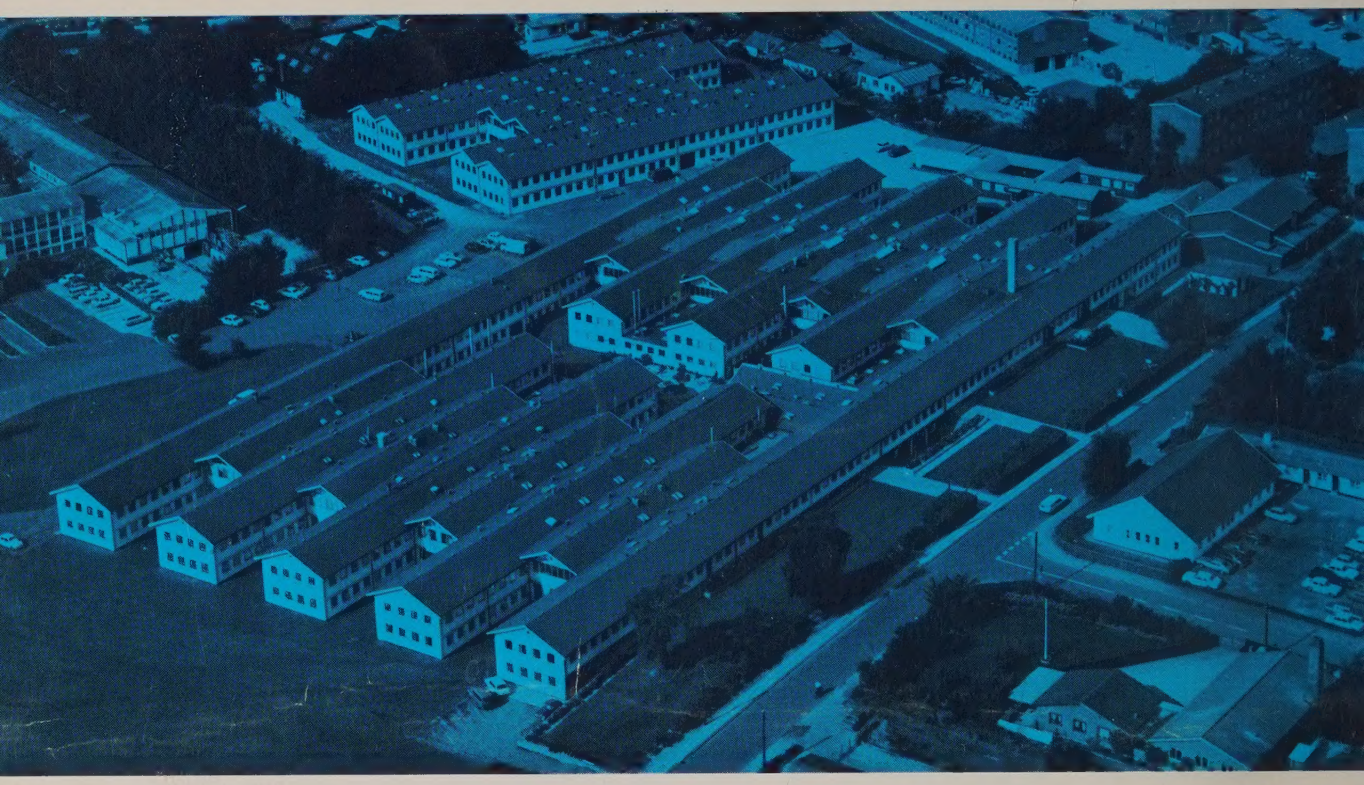


Fig.3.5. Equivalent electrical circuit diagram for 1013 mbar and 25°C

For further discussion of the equivalent circuit see B & K Technical Review 1971 No. 4, "Acoustical Calibrator Type 4230 and its Equivalent Diagram".



BRÜEL & KJÆR instruments cover the whole field of sound and vibration measurements.
The main groups are:

ACOUSTICAL MEASUREMENTS
Condenser Microphones
Piezoelectric Microphones
Microphone Preamplifiers
Hydrophones
Sound Level Meters
Precision Sound Level Meters
Impulse Sound Level Meters
Noise Dose Meters
Noise Level Analyzers
Standing Wave Apparatus
Calibration Equipment
Reverberation Processors
Sound Sources

ACOUSTICAL RESPONSE TESTING
Sine Generators
Random Noise Generators
Sine-Random Generators
Artificial Voices
Artificial Ears
Artificial Mastoids
Hearing Aid Test Boxes
Audiometer Calibrators
Telephone Measuring Equipment
Audio Reproduction Test Equipment
Tapping Machines
Turntables

VIBRATION MEASUREMENTS
Accelerometers
Force Transducers
Impedance Heads
Accelerometer Preamplifiers
Vibration Meters
Accelerometer Calibrators
Magnetic Transducers
Capacitive Transducers
Complex Modulus Apparatus
Bump Recorders

VIBRATION TESTING
Exciter Controls — Sine
Exciter Controls — Sine — Random
Exciter Equalizers, Random or Shock
Exciters
Power Amplifiers
Programmer Units
Stroboscopes

STRAIN MEASUREMENTS
Strain Gauge Apparatus
Multipoint Selectors

MEASUREMENT AND ANALYSIS
Voltmeters
Phase Meters
Deviation Bridges
Measuring Amplifiers
Band-Pass Filter Sets
Frequency Analyzers
Real Time Analyzers
Heterodyne Filters and Analyzers
Distortion Measuring Equipment
Psophometers
Statistical Distribution Analyzers
Tracking Filters

RECORDING
Level Recorders
Frequency Response Tracers
Tape Recorders
Alphanumeric Printers
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DIGITAL EQUIPMENT
Computers
Tape Punchers
Tape Readers

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